AVTEC Replacement Card Study Report

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AVTEC REPLACEMENT CARD STUDY

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1. PURPOSE

The purpose of the ICS serial communication card study was to evaluate an alternative device for use in serial data communication. The objective of the evaluation was to determine if there were lower-cost, commercially available devices that could satisfy serial data communication requirements for spacecraft simulators and other test equipment used to support NASA missions. Five different vendors were initially considered for this study. The primary evaluation criteria included cost, performance, and ability to meet mission critical requirements. Three vendors were eliminated from consideration based on these criteria. The work reported here focused on the comparison between comparable serial data communication cards developed by AVTEC and by Industrial Computer Source (ICS). AVTEC has high-speed serial communication cards, which are currently in use in many simulation and data transmission pieces of equipment located at various NASA facilities. The ICS fast serial card was identified as an alternative commercial-off-the-shelf (COTS) product that appeared to have an equivalent capability and cheaper cost.

2. APPLICABILITY

This study applies to all missions that require RS422 or TTL serial data communication.

3. REFERENCES

The following publications contain related information:

- Data communication text book
- Industrial Computer Source FASTCOM/ESCC-P serial communication manual
- Reference manual: CONTROLLER SIEMENS 82532 manual
- AVTEC high speed serial card ISA manual

4. PROCEDURE

The following section is divided into three parts: Hardware, Software, and Process. Each part contains its requirement to perform the functional tests.

Hardware:

The following hardware was used in this evaluation:

- Pentium II 300 processor based PC
- Industrial Computer Source high speed serial PCI card
- AVTEC high speed serial communication ISA card
- Frame Synchronizer and Bit Synchronizer hardware to measure the quality of data

Software:

The following software was used in this evaluation:

- “C” function routines to run the test
- Windows NT release 4.0 Operating System
- Windows NT system interrupt scheme to measure the interrupt response time

- Data Quality Monitor (DQM) to detect any data bit slips

Process:

The hardware and software listed above were used in this evaluation and as tools in the analysis. The test was able to maintain the standard interface test by utilizing an industry standard method (API) within the Windows NT environment.) This study was conducted as follows:

- Simulations Operation Center (SOC) hardware equipment was utilized to test precise data quality measures.
- Input and output test program routines written in "C" were developed to provide an easy and quick mechanism to evaluate and compare performance on several card features.
- Data Quality Monitor (DQM) device was used for the purpose of data bit slip detection.
- Windows NT standard API was used to apply interrupt response timing and blocking scheme.
- Multiple routines, input and output tasks, were used simultaneously to perform concurrent data flow and maintain the integrity of the system idle time at the same time. The test was performed in a multiple threads Windows NT environment.
- CCSDS data formats commonly supported by today's missions were used for the test.
- Identical routines were used on both serial cards for the purpose of comparing common features on each card.
- Bit synchronizer and frame synchronizer were utilized for data lock and drop check.

4.1 Requirements Analysis

In practical applications involving standard serial communication, the card of choice will be the one that meets mission critical tasks. For the purposes of this evaluation, the following are the mission requirements for the serial communication. The card must be able to:

- Send telemetry data in CCSDS and TDM format
- Receive command data in CCSDS and TDM format
- Apply input and out code conversion
- Perform high and low data rate
- Maintain industry standard PCI
- Perform auto polarity check (optional)
- Provide system level interrupt response

The card must provide the above-described capabilities in each independent test. The test must be conducted in the SOC environment. The test must be verified with SOC technical personnel.

4.2 Results and Conclusions

The ICS fast serial communication card is a viable alternative to the AVTEC high-speed serial communication card in some situations. The ICS serial card is well designed and can be used in general purpose serial communication. The study looked at performance, reliability, and cost of the ICS card. The performance is well above the expectation. We were able to receive and transmit data at rates up to 3 Mbits/sec without any errors. We were also able to flow data over the long duration (more than three days) and there was no indication of any problems. Because of the ICS card "first-in, first-out" (FIFO) buffer size (64 bytes), we were be able to handle low data rates over the long period of time successfully. This is an important issue when critical mission requirements include support for a low data rate. The AVTEC card cannot handle the low data rates. This is due to the large size of FIFO (8K) that resides in the AVTEC card, which causes a significant delay in response time that often exceeds acceptable limits for required spacecraft response time. The FIFO plays a very important role when telemetry and command throughputs or processing require quick response time.

The cost is also an important issue. The ISC card is considerably less expensive. It costs $500 and has two input channels and two output channels whereas the AVTEC card costs more (about $3,000 per card) and only supports

one input and output channel. This can be a substantial cost saving if a mission requires multiple telemetry outputs. For example, a system requiring two channels could perform this function with one $500 ICS card, whereas a comparable system using AVTEC boards would require two at a cost of about $6,000. The ICS serial card can also be able to perform NASCOM blocking/deblocking functions, IP to serial conversion, and serial to IP conversion tasks.

This card, however, can not provide some of the capabilities typically performed by the Programmable Telemetry Processors in use. This is due to the limitation in the hardware itself in that the card is not equipped with a "frame synchronizer", which is one of the primary functions. This frame synchronizer capability however, may not be important in all cases, and it could alternatively be provided in software. Additionally the ICS vendor could modify the card to include the frame sync. function if required.

Table 1.0 contains the detailed results of the comparisons performed between the two serial data communication cards.

Table1.0 result of each function test.

Capabilities	**ISC serial IO**	**AVTEC serial IO**	**Remarks**
Serial 422 Input/Output	Yes	Yes	Excellent performance on both
Serial TTL Input/Output	Yes	Yes	Excellent performance on both
Input code(NRZ,BIO)	Yes	Yes	Excellent performance on both
Output code(NRZ,BIO)	Yes	Yes	Excellent performance on both
I/O interrupt driven	Yes	Yes	Excellent performance on both
Input/output rates up to 3 Mbit/sec	Yes	Yes	Excellent performance on both
Number of channel per card	2 input channels 2 output channels	1 input channel 1 output channel	ISC card advantage
Auto polarity check	No	Yes	ICS card limitation
Data polarity	Yes	Yes	Excellent performance on both
Frame sync. function	No	Yes	No capability on ICS card
Simulate low data rate	Yes	No	Very poor on AVTEC card
Simulate high data rate	Yes	Yes	Excellent performance on both
PCI industry standard slot	Yes	No	Poor on AVTEC card

Clock rate change on the fly	Yes	No	Excellent performance on ISC but poor on AVTEC card
IP to serial conversion	Yes	Yes	Excellent performance on both
Windows NT system stability	Yes	Yes	Excellent performance on both
NASCOM blocking/deblocking capability	Yes	Yes	Excellent performance on both

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